173.23 grains, in twenty-four hours, 126.76 grains being the average of the results obtained by fifteen observers.

Lactic Acid, if present, is so in very small quantity. *Ammonia* is met with, according to Neubauer, in quantity equal to 7 or 8 grains.

Potash, Soda, Lime, and *Magnesia*, are excreted to the amount of about 120 grains in the twenty-four hours.

The variations which are induced by age, sex, food, drinks, exercise, &c., are next fully considered, and much important information is collected under this head.

The effects of certain medicines are next brought under notice, and then the second book is reached, which treats of the *Urine in Disease*. More than half the treatise is embraced in this section, and little of any importance seems to have escaped the author.

In conclusion, we can recommend Dr. Parkes' work to practising physicians, as one calculated to be of much service to them, and to those commencing or engaged in the study of the physiology or pathology of the urine, it cannot fail to be of great value. W. A. H.

ART. XXI. — *On Diphtheria.* By EDWARD HEADLAM GREENHOW, M. D. Fellow of the Royal College of Physicians, Physician to the Western General Dispensary, and Lecturer on Public Health at St. Thomas's Hospital. 8vo. pp. 160. New York, 1861: Baillière Brothers.

Diphtheria: its Nature and Treatment, with an Account of the History of its Prevalence in Various Countries. By DANIEL DENISON SLADE, M. D., of Boston, Mass. The Dissertation to which the Fiske Fund Prize was awarded, July 11, 1860. 8vo. pp. 60. Philadelphia, 1861.

Diphtheria: its History, Nature, and Treatment. By WM. HENRY THAYER, M. D., Professor of Theory and Practice of Medicine, in the Berkshire, Mass. Medical Institution. From the Berkshire Medical Journal. 8vo. pp. 38 Pittsfield, Mass. 1861.

THE three publications the titles of which are given above have been called forth in consequence of the somewhat extensive prevalence of diphtheria for some time past in different portions of Europe and this country. The first is based upon a careful study of the disease in public and private practice, in conjunction with information obtained in the course of an inquiry made by its author for the English Privy Council in the spring of 1859. It forms a tolerably complete monograph on diphtheria, presenting its history as it prevailed epidemically under different names, in various countries and localities, during the sixteenth, seventeenth, eighteenth, and nineteenth centuries; with copious references to the notices which the disease has received from medical writers who flourished near or during the periods of its prevalence.

The second essay obtained, as stated in its title page, the prize of the Fiske fund for 1860. It presents a very complete exposition of the literature of diphtheria, from the earliest periods to which published notices of the disease can be traced down to the present day, and exhibits a clear and faithful account of nearly all that is known in respect to its symptoms, nature, course, and treatment. The essay will be found entire in the last number, page 145 *et seq.* of this Journal.

The third essay, though less full in its reference to the writers who have treated of diphtheria, presents a very fair and instructive digest of the leading facts that have been developed in respect to its etiology, symptomatology and treatment.

Though comparatively rare as a sporadic affection, especially in its more severe and malignant forms, diphtheria has been repeatedly observed as an epidemic, extending either simultaneously or successively over extensive regions of country, or even distant lands, including portions of the old and new worlds.

More commonly, however, we find it, in certain directions and at particular periods, limited to a single district, neighbourhood, or even house, not a case of the disease even in its mildest form being met with beyond these infected spots.

The entire history of diphtheria, its wide extension at one time, and its limitation within a more or less circumscribed area at another—its tendency to linger in particular localities, or to return repeatedly to the same neighbourhood—its varying intensity in different places, showing itself in one as an affection of great mildness, and in another as one of extreme malignancy and but little under the control of any system of remedial treatment, would seem to indicate that, while the disease owes its origin to some wide-spread aërial influence, some zymotic cause existing in the atmosphere generally, which when received into the blood brings it more or less quickly into a morbific condition, this influence or cause, whatever may be its nature and origin, is modified in the direction and intensity of its action from certain local conditions connected with either population or locality.

Although new to the physicians of the present day in its epidemic form, diphtheria has nevertheless been accurately described under other names by many of the older medical writers. One of the most graphic accounts we have of it is that given by Dr. Samuel Bard, who in 1789 published an inquiry into the nature, cause and cure of the *angina suffícatíva* or sore-throat distemper which prevailed in New York in 1771; an affection evidently identical in all respects with the prevailing epidemic.

From the fact that diphtheria and scarlet fever have been very generally observed to prevail simultaneously in the same place, neighbourhood, and house, often even in the same individual, the identity of the two diseases has been inferred by some writers. That diphtheria and scarlatina are closely related to each other there can be little doubt, but that they are not one and the same affection, nor yet, as others have supposed, merely different forms or varieties of the same disease, must, we think, be evident to any one who will carefully study their history. The distinctness of the two would seem to be very clearly shown by the infrequency of a second attack of scarlet fever, and when it does occur its usually mild character, while on the contrary nothing is more common than for the same individual to experience a second or even third attack of diphtheria, within a short period of each other, and often of increased severity. Their non-identity is further shown by the entire failure of any immunity from the attack of scarlatina, in the otherwise unprotected, being afforded by the occurrence of diphtheria, or from an attack of the latter by a previous attack of scarlet fever. Further evidence of their non-identity is not wanting. Thus Dr. Greenhow refers to the absence of any *scarlatinal rash* in cases of pure diphtheria or in connection with such cases during extensive epidemics of the last named disease.

"Albuminuria," Dr. G. remarks, "an occasional symptom of both diseases, occurs at very different stages in the two; in scarlet fever it rarely or never occurs until the primary and characteristic stage of the disease is past. In a series of cases of scarlet fever, in which the urine was carefully examined day by day by himself, with a special reference to this question, he found albumen during convalescence in nearly all, but as early as the tenth day from the appearance of the rash, in only a single instance; more frequently it was not met with until the twelfth or thirteenth day. In only one of the cases, that of an adult, was the albuminuria attended by anasarca. In diphtheria, on the contrary, albuminuria is of less frequent occurrence, if the above-mentioned cases are to be received as an index of the frequency of its existence after scarlet fever, and when it does occur, it is at an earlier period of the disease, sometimes within a few hours of the commencement of the illness. Dr. G. has notes of a case in which he found albumen in the urine thirty-six hours after the first symptoms of indisposition, and before the exudation had attained its maximum intensity."

In addition to the foregoing marks of distinction between scarlatina and diphtheria, Dr. G. notices the frequency of croupal symptoms in the latter compared with the infrequency of their occurence in the former disease. Anasarca, a common sequela of scarlatina, is very rare in diphtheria, as is also the peculiar kind of arthritis which sometimes follows scarlatina. The same remark may be made with respect to suppuration of the glands of the neck, pericarditis and chorea.

"Besides the absence after diphtheria of the well known sequelæ of scarlet fever, the former disease is succeeded by sequelæ of a character peculiar to itself, and such as have not been found to follow scarlet fever. These are, partial paralysis of the muscles of deglutition and voice, impairment or disorder of vision, paraplegia, hemiplegia, partial paralysis of the upper extremities, numbness of the hands or feet, tenderness, pricking or tingling of the extremities, and gastrodynia. Then, lastly, the occurrence of diphtheria on other parts of the body, as on abrasions of the skin, or wounds, or on the pudenda, has no parallel in scarlet fever. When to these differences we add that the anæmia which soon occurs, and for a long time succeeds to diphtheria, is more intense than in almost any other acute disease, there can be little hesitation in accepting the conclusion that diphtheria and scarlet fever are not the same disease."

A much closer relationship may be traced between diphtheria and epidemic erysipelas, than between it and scarlatina. The two have been known repeatedly to prevail in conjunction. Erysipelas of a severe and unmanageable character will sometimes commence, increase, and decline simultaneously with diphtheria. Dr. Greenhow reports an instance of this commingling of the two diseases as observed by Dr. Nicholson in Reddich, England.

In the monograph of Dr. Greenhow reference is made to the supposed intimate relationship between diphtheria and the lung distemper, or pleuropneumonia of cattle. The two have, in many districts of country, prevailed at one time, and it is a somewhat curious and significant fact that after an absence of many years, within a short period the two should have appeared again simultaneously.

"What renders these cattle epidemics peculiarly interesting in connection with the present subject, is," remarks Dr. G., "the fact that, although the time of their appearance, twenty years ago, they were quite new to the existing generation of dairymen, farmers, and cow doctors (there being no record of their existence in this country during at least the preceding half century), pulmonary murrain, preceded by an eruptive murrain, prevailed about the middle of the last century, just before the outbreak of diphtheria which then occurred. Towards the close of the first half of the century, when Fothergill, Cotton, Huxham, Starr, and other writers, were describing the diphtheria epidemic then prevalent, an anonymous member of the College of Physicians, and Drs. Brocklesly, Hurd, and Layard, wrote their accounts of the murrain then prevailing epidemically among horned cattle. This may, indeed, have been a mere coincidence, but that the appearance of the eruptive and pulmonary diseases among cattle, and of diphtheria in the human subject, are in some measure attributable to the operation of a common cause, seems more than probable, seeing that several of the older writers on *morbus strangulatorius* (diphtheria,) mention its coincidence with certain diseases among cattle. Thus Ghizi says, there was a great resemblance between the epidemic angina which prevailed at Cremona in the years 1747 and 1748, and a disease affecting the respiratory passages at that time prevalent among oxen. Dr. Wall, speaking of the epidemics in England about the middle of the eighteenth century, says, 'This disease has so great a resemblance to the epidemic sickness amongst cattle, that I am persuaded it is of the same nature.' Severinus, who wrote in the seventeenth century, also mentions that a great mortality among cattle preceded the appearance of malignant sore throat, and M. Malouin, in his account of the epidemic diseases observed at Paris in 1746, says, that the disease among cows had already appeared in France when children were attacked by epidemic sore throat. The same reporter, in his remarks upon the diseases of October, 1748, when the form of epidemic sore throat—*maux de gorge gangréneux*—was again prevalent, says it had been noticed that oysters disagreed with every one who ate them during the month, especially before the weather became cold."

Diphtheria has not made its appearance exclusively in any particular season, climate, or locality. The warmest and the coldest season of the year, the most inclement as well as the most pleasant climate; the highest and driest situations equally with the low and marshy have been visited by the disease. It has appeared in the open country and in the most densely populated cities; in the badly located quarters, and the ill constructed and badly kept habitations of the poor, and in the comfortable well ventilated mansions of the wealthy. In short, the disease has not been found to spare places and neighbourhoods and residences whose sanitary condition is to all appearance unexceptionable, and yet it is evident from the history of the several epidemics of diphtheria on record, and the facts collected by contemporary observers, that it is in those districts, localities and houses which are generally recognized as unhealthy that the largest number of its victims are always found. Here too it presents itself in its worst forms, and is productive of the largest amount of mortality.

The major portion of those attacked by diphtheria have been children between two and twelve or thirteen years of age. The susceptibility to the disease diminishes rapidly after puberty, and is very slight in infancy. The tendency to a fatal result diminishes also with the progress of life. Persons, however, of fifty, sixty, and even seventy years of age have been known to suffer from very severe attacks of diphtheria.

The propagation of the disease by contagion is much insisted on by many writers, while others are as positive that it is neither contagious nor infectious. As is the case with all epidemic maladies, when diphtheria makes its appearance in one member of a household it is very common for most or all the other members to suffer from it either within a very short period of the first, or one after the other at irregular intervals; or, when it occurs in a neighbourhood, to spread as it were from house to house; not because of the contagious character of the disease, however, but from the fact that all who are attacked in the household or neighbourhood, have been exposed alike to one common atmospheric morbific influence. The successive occurrence of the disease in persons all equally exposed to the same epidemic cause can be readily explained without the necessity of supposing that the subsequent cases were produced by a contagious matter emanating from the bodies of those first attacked. It is known that, in very many instances only a single member of a family, and only one or two patients in the same neighbourhood, have suffered from the disease, notwithstanding not the slightest restraint had been interposed upon the free intercourse of the sick and the well. In the report of the committee on diphtheria of the Epidemiological Society of London, the disease is said to have been of doubtful contagiousness in some districts, but undoubtedly contagious in others. A statement which in our estimation casts a very great degree of doubt upon its communicability by a specific contagion in any district.

A digest of the leading facts bearing upon the question of the contagiousness of diphtheria, will be found very fully and candidly set forth in all three of the works before us.

According to Dr. Greenhow, death in diphtheria is in one class of cases preceded by all the symptoms of collapse occurring in cases of fatal gangrene, or by a profuse hemorrhage. Usually death is caused by entire exhaustion of the powers of life by the violence or very protracted course of the disease, or the fatal event is preceded by syncope. In other instances death results from the extension of the diphtheric deposit from the throat into the larynx, presenting thus a mechanical obstruction to respiration. The sudden deaths attributed to exhaustion of the powers of life, there is reason to believe result, in some instances at least, from the formation of heart clots. This is especially the case in those instances of sudden death that occur in patients who had presented no alarming symptoms up to the period of their demise, or at a period of the disease when the patient was, to all appearance, out of danger. The fatal result is in a few instances preceded by convulsions.

Dr. Greenhow enumerates as signs of great danger, the occurrence of croupy symptoms, or of pneumonia, a brown or blackish appearance of the diphtheritic deposit, hemorrhage from the nose, throat, lungs, or intestines; purpura; copious discharge of matter from the nostrils; intense albuminuria; extensive swelling of the glands of the neck; marked diminution of temperature; sickness and diarrhœa, especially at an advanced period of the attack. Either of the symptoms denotes a severe case; but when, as sometimes happens, two or three are combined, the danger must be regarded as imminent.

Diphtheria is liable to be complicated or followed by bronchitis, less frequently by pneumonia. In the former, besides the stethoscopic signs of bronchial inflammation, there is expectoration of a frothy or glairy fluid, intermingled with which there are often seen casts of the bronchial tubes. The presence of pneumonia, by which diphtheria is occasionally complicated, is frequently unsuspected during life, its existence being first revealed only upon an examination of the body after death. In respect to the morbid anatomy of diphtheria, with the exception of what relates to the abnormal condition of the throat, we have few very accurate observations. In the greater part of the published results of examinations after death in cases of diphtheria, no attempt has been made to distinguish those lesions present which are to be esteemed proper to the disease, and those which had been the result of accidental or intercurrent maladies.

The fauces are generally found after death to be covered to a greater or less extent with an abnormal deposit, varying in consistency from that of a semifluid, pultaceous matter, to that of a firm, consistent, and more or less elastic membrane, having a thickness of from a quarter of a line to several lines. Its outer surface is sometimes uneven, at others flocculent or fissured, and less dense than the deeper portion. In many cases the membraniform deposit is dry and of a granular appearance. Low forms of cryptogamic plants are occasionally seen upon it. Examined by the microscope, the membraniform deposit is found, according to Dr. Greenhow, to consist of coagulated fibrin and epithelium, the latter being most abundant in the outer layer, the deeper portion being more purely fibrinous. Exudation cells are often intermixed with the fibrillated texture. In some cases the deposit is more or less stained with blood. From being simply opaque, it soon becomes white or ash coloured, or if thick and adherent, brownish or buff coloured; when stained with blood, blackish. It is sometimes very loosely, at others very firmly adherent to the subjacent surface; occasionally, especially when friable and granular, it is merely superimposed upon the natural surface.

The mucous membrane upon which the pseudo-membranous deposit occurs is often intact; generally it is much congested and swollen. Sometimes it is white, opaque, or unnaturally pale, or, it has a raw appearance, the epithelium having been shed with the false membrane. It often has an excoriated and roughened appearance, is occasionally ulcerated, and more rarely gangrenous. When the adherent deposit is raised up, it is often seen to be attached to the surface beneath by numerous small filaments, as though processes of the deposit passed into the mucous follicles. When removed, in such cases, the mucous membrane is more or less dotted with bloody points.

"The submucous tissue is often œdematous, infiltrated with blood, and sometimes the seat of interstitial exudation. The tonsils are usually swollen, and on being cut into, are often infiltrated with blood, so as to impart to them an ecchymosed appearance; sometimes their tissue is softened. In two instances Dr. G. found the centre of a tonsil in a state bordering on gangrene. There is generally more or less inflammatory effusion into the structure of the tonsils. In one instance, on the tonsil being laid open, there was an oozing from it of a creamy fluid resembling pus. In some instances, the œsophagus and the muscular and other tissues around the fauces are congested or infiltrated with blood. The parotid and submaxillary regions are much swollen, and the integuments studded with livid purpureous spots."

In cases where the pseudo-membranous deposit extends to the larynx and trachea, it generally diminishes in thickness and firmness as it descends into the air-passages, until it assumes finally the form of a very thin pellicle or of a creamy fluid. There is usually more or less congestion of the mucous membrane of the affected portions of the larynx and trachea. It is often thickened, also, so as to diminish the calibre of the passage, even after the false membrane has been removed or has separated. The same remarks are true in reference to the subjacent mucous membrane here as were made when speaking of that of the fauces. The epiglottis, besides being covered on its upper and lower surface with false membrane, is often swollen so as to contract the entrance to the windpipe. The bronchial tubes are sometimes lined with the diphtheritic deposit to the third or fourth bifurcation, or even beyond. The lungs are sometimes emphysematous, or they may be affected with pneumonia, usually of the lobular form. The kidneys are sometimes entirely healthy, in other cases they have been found congested, and presenting under the microscope when sliced, transparent fibrinous casts of the tubes, which occasionally contain blood-corpuscles, or granules of hæmatine, or a few altered epithelial cells.

There is a very general agreement among those who have had an opportunity for studying diphtheria, as to the necessity of a tonic and stimulant treatment from the very onset of the disease. It has been recommended, and we think with propriety, to commence the treatment when the patient is seen immediately when attacked by the administration of a prompt emetic of sulphate of zinc, followed by a moderate purgative of castor oil and turpentine.

The most efficient internal remedies are Watson's chlorine mixture, or, a simple solution of chlorate of potass in syrup and water, with a minim of dilated hydrochloric acid to each grain of the salt, given with the tincture of sesquichloride of iron; the dose being in each case proportioned to the age and condition of the patient, and repeated every three, four, or six hours. This mixture Dr. Greenhow prefers in cases unattended with urgent symptoms, and where the deposit is firm, and there is no tendency to hemorrhage. When the mucous membrane surrounding the deposit is deeply injected and softened, abrading and bleeding on the slightest touch, or whenever there is albuminuria, he considers the tincture of the sesquichloride of iron alone, in full and frequent doses, to be the proper remedy. If there is a tendency to purpura, he recommends the addition of from five to ten or twelve minims of diluted hydrochloric acid. When the hemorrhagic tendency coexists with great fetor of breath, the tincture of sesquichloride of iron should be given in conjunction with the chlorine mixture.

When there is great depression from the onset of the attack, ammonia given in decoction of cinchona is sometimes very useful, but in most cases it will be found inferior as a stimulant to good wine, or to brandy combined with egg or milk. The quantity and repetition of these must be regulated by the state of the circulation, care being taken to so time their employment and regulate their amount as to prevent, both day and night, any rapid or considerable flagging of the pulse. In cases occurring in young children a resort to suitable nutriment, will render the use of any large amount of alcoholic stimulants unnecessary, and by proper management the patient may almost always be got to swallow nutritious substances. The best of these are beef-tea, properly prepared; chicken broth, new milk, cream, and fresh laid eggs soft boiled, or, in cases where alcoholic stimulants cannot be dispensed with, beaten up with wine or brandy.

In the croupal form of diphtheria, as soon as the embarrassment of respiration is observed, and the patient's strength will admit of it, an emetic of sulphate of zinc and ipecacuanha should be given and followed by small repeated doses of calomel or hydrargyri c. cretâ; nutriment and stimulants being at the same time given freely and regularly, so as effectually to sustain the patient's strength. In these croupal cases we have found a combination of calomel, muriate of ammonia, ipecacuanha, and extract of hyoscyamus often to afford very prompt and decided relief. All external applications to the throat, poultices, fomentations, rubefacients and blisters, do far more mischief than good. As convalescence becomes established, fresh fish, oysters, chicken, tender-loin steaks, mutton chops or other solid food, nutritious and easy of digestion, should be given as early as possible.

The patient throughout the attack of diphtheria should be confined to his bed, and until convalescence is confirmed, he should still retain the recumbent position. Sudden movements, and active exertions of every kind should be avoided until the strength has become fully re-established. Even for some time after recovery has been apparently confirmed, it will be prudent to give a little light nourishment, or a glass of wine and water, each time before active exercise is taken.

In respect to local treatment, whatever may be the benefit derived from the direct application of nitrate of silver, or of a slightly diluted tincture of the sesquichloride of iron, or from the use of a gargle of the latter in a still more diluted form and sweetened with honey, in the early stage of the attack, when there is but a small amount of deposit and that on the anterior portion of fauces, at a later period of the disease, they are, to say the least of them, in most cases of very doubtful propriety; in many instances they are absolutely and to some extent injurious. In all cases mild, soothing detergent applications will, as a general rule, be productive of the most good.

"Simple gargles of borax or alum dissolved in water, or of solution of chloride of soda, in the proportion of half a drachm of the solution to the ounce of water, in either case sweetened with honey," are said by Dr. Greenhow, to "bring away the foul secretions and loose flakes of exudation, and thus, both by cleansing the mouth, and lessening the obstruction about the fauces, very materially to facilitate the administration of remedies and nutriment. Such gargles may be used either cold or tepid, as is most agreeable to the patient, and in very young children, or whenever patients are unable to gargle, they may be injected into the throat with a syringe, the patient's face being held over a basin immediately afterwards, so as to facilitate the return of the liquid together with the secretions and debris of the exudation which it may have detached. Probably in many cases, a simple injection of tepid water might answer the purpose equally well." Dr. G. has seen little benefit derived from the use of the chlorinated gargle, except where the breath was fetid from the decomposition of the exudation within the fauces. When the excretion has cleared away, and the throat is free from ulceration or excoriation, it is well to discontinue all local treatment, time being usually the best remedy. Sometimes the throat remains slightly congested or relaxed, or very sensitive to changes of weather for a long time after an attack of diphtheria. In the former of these cases the gargle, with the tincture of sesquichloride of iron already mentioned, has been the most useful application in Dr. G.'s experience. In the latter, he is accustomed to trust to constitutional treatment, gargling the throat with cold water, and, especially when the advice can be followed, to commend change of air.

The several forms of nervous disease which follow diphtheria usually disappear with time, but the cure is often promoted by judicious change of air and scene, good nourishment, and the use of tonics. Diluted nitromuriatic acid with the infusion of gentian or calomba, will often be found to suit the patient; citrate of iron and quinine also are often very useful. When there has been albuminuria or purpura, or the patient is extremely anemic, the tincture of sesquichloride of iron, with or without a few minims of diluted hydrochloric acid, or a grain or two of quinine to each dose, according to circumstances, is often serviceable. In some cases sulphate of quinia combined with diluted sulphuric acid, in any proper vehicle, will be found the best tonic. In cases where paraplegia has followed diphtheria, minute doses of strychnia are said to have been sometimes useful. "On the whole," remarks Dr. Greenhow, "though convalescence is usually much protracted, patients for the most part recover perfectly from the anæmia and purely nervous sequelæ of diphtheria, provided they survive the sixteenth or seventeenth day of their illness; and though tonics should certainly be persevered in, if they appear useful, there can be no doubt that they ought to be discontinued, if they do not agree with the patient nor appear to accelerate his recovery, seeing that time and good nursing will, in all probability, restore him to his pristine health." D. F. C.